Don’t Pop the Balloon!

Some things in this world just don’t mix: dogs and cats, oil and water, needles and balloons. Everyone knows that a balloon’s worst fear is a sharp object…even a sharpened, wooden cooking skewer. With a little scientific knowledge about polymers, you’ll be able to perform a seemingly impossible task…pierce a balloon with a wooden skewer without popping it!

Materials: Balloons Cooking Oil Wooden cooking skewers Sharpies

Directions:

1. Inflate a balloon until it’s nearly full size and then let about a third of the air out. Tie a knot in the end of the balloon.
2. If you examine the balloon you’ll notice a thick area of rubber at both ends of the balloon. This is where you’ll pierce the balloon with the skewer.
3. Dip the tip of the wooden skewer into the cooking oil
4. Place the sharpened tip of the skewer on the thick end of the balloon and push the skewer into the balloon. Be careful not to jab yourself or the balloon with the skewer. Just use gentle pressure to puncture the balloon.
5. Push the skewer all the way through the balloon until the tip of the skewer touches the opposite end of the balloon where you’ll find the other thick portion of the balloon. Keep pushing until the skewer penetrates the rubber.
6. Gently remove the skewer from the balloon. It will deflate but won’t pop.

Let’s do it again, but this time you’ll see the hidden “stress” in a balloon.

1. Before blowing up the balloon, use the Sharpie pen to draw about 10-15 dots on the balloon. The dots should be about the size of the head of a match. Be sure to draw them at both ends and in the middle of the balloon.
2. Inflate the balloon half way and tie the end. Observe the various sizes of the dots all over the balloon.
3. Judging from the size of the dots, where on the balloon are the latex molecules stretched out the most? Where are they stretched out the least?
4. Dip the tip of the wooden skewer in the vegetable oil and use your fingers to coat the skewer with oil.
5. Use the observations that you made previously about the dots on the balloon to decide the best spot to puncture the balloon with the skewer. Of course, the object is not to pop the balloon!

**How Does It Work?**

The secret is to uncover the portion of the balloon where the latex molecules are under the least amount of stress or strain. After drawing on the balloon with the Sharpie marker, you probably noticed that the dots on either end of the balloon were relatively small. You’ve just uncovered the area of least stress... the ends of the balloon. When the point of the skewer is positioned at the ends of the balloon, the solid object passes through the inflated balloon without popping it.

If you could see the rubber that makes up a balloon on a microscopic level, you would see many long strands or chains of molecules. These long strands of molecules are called *polymers*, and the elasticity of these polymer chains causes rubber to stretch. Blowing up the balloon stretches these strands of polymer chains. Even before drawing the dots on the balloon, you probably noticed that the middle of the balloon stretches more than either end. You wisely chose to pierce the balloon at a point where the polymer molecules were stretched out the least. The long strands of molecules stretched around the skewer and kept the air inside the balloon from rushing out. It’s easy to accidentally tear the rubber if you use a dull skewer or forget to coat the end of the skewer with vegetable oil. When you remove the skewer, you feel the air leaking out through the holes where the polymer strands were pushed apart. Eventually the balloon deflates… but it never pops. Or, just to prove your point, try pushing the skewer through the middle part of an inflated balloon. Well, at least you went out with a bang